SECTION A

HARDWARE REFERENCE MANUAL

RELEASE 3 FOR DOS

B-SERIES

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1.0 INTRODUCTION

The PIKA AVA B Series or 'Audio/Voice Adapter' family of products are used to provide a means of recording and reproducing audio or speech sounds with a computer.
The PIKA AVA products convert continuously changing audio signals into a series of discreet numerical 'samples' representing the magnitude of the audio signal at fixed time intervals. This process is know as 'ANALOG TO DIGITAL CONVERSION'.
Strings of binary encoded audio samples can be stored on a computer's hard disk for future recovery, without any degradation, and for indefinite lengths of time .
The PIKA AVA can recall stored strings of binary encoded audio samples as required, and re-construct the original audio/voice signal. This process is know as 'DIGITAL TO ANALOG CONVERSION'.
The quality of audio reproduction in digital audio sampling systems is affected predominantly by two factors:

1. Sampling rate: This is a measure of the rate at which audio signal magnitude is sampled and converted into binary representations.
   As the sampling rate goes up, the quality of audio reproduction increases.
2. Sample size: This is number of bits which are used to represent the binary samples of audio magnitude.
   As the maximum number of bits per sample increases, the quality of audio reproduction increases.

It is evident that to achieve the best audio reproduction quality, the highest possible sampling rate and largest sample size should be used. It is also evident that the requirement for more mass storage (ie hard disk size) increases as audio quality increases.
The PIKA AVA product family makes use of a practical method of representing digitized audio by a technique called 'ADAPTIVE DELTA PULSE CODE MODULATION' or 'ADPCM'. This scheme represents audio as a series of 4-bit binary values, which adapt their meaning to changing average audio input levels.
ADPCM provides optimum audio performance and minimal hard disk storage requirements. Options have been provided on the PIKA AVA cards to allow users to select from a wide range of audio sampling frequencies.

1.1 PIKA AVA Interfaces:

The PIKA AVA products provide computers with two basic types of interface to the real world: Direct Audio, and Telecom.

1.1.1 Direct Audio interfaces

The PIKA AVA products provide LINE or MICROPHONE compatible audio inputs for general purpose recording.

- LINE level inputs are typically 1 to 2 volts peak to peak, and are generated by tape decks, CD players, headphone outputs etc.
- MICROPHONE level inputs are typically 5 to 10 millivolts peak to peak and are generated by microphones.

Monitor outputs are also provided as general purpose audio outputs. The PIKA AVA monitor output ports are designed to drive impedances greater than 100 ohms, so they cannot drive typical 4 to 8 ohm loud speakers directly.

- The Monitor port is typically used in conjunction with an external amplifier, amplified speakers, or high impedance headphones (ie 32 ohms or greater).

1.1.2 Telecom interfaces

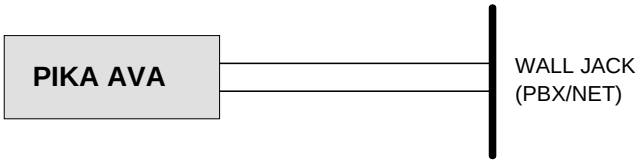
The PIKA AVA products provide interfaces for practical telecommunications applications.

The common feature of the PIKA AVA B Series is a LOOP START interface on each circuit for direct connection to a PBX or the public phone network (ie NET/PBX port). This interface is used to connect the PIKA AVA to a telephone system.

In simple terms, this interface makes the phone system 'believe' that each phone line connected to an PIKA AVA NET/PBX port is in fact connected to a regular single line phone, and that an intelligent human is using it.

The PIKA AVA provides all the functions necessary for phone line applications, including:

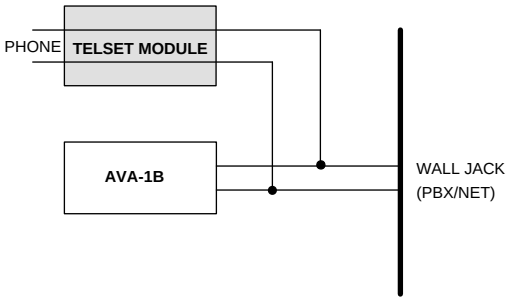
- Detection of ringing (ie somebody is calling in).
- Taking the line 'off-hook' (ie answer/start a call).
- Detecting touchtone (DTMF) digits.
- Dialing touchtone (DTMF) digits.
- Detecting if outgoing calls are successful (ie somebody answered, the line is busy etc).
- Detecting if the caller has hung up at the far end.



NET/PBX PORT TO PIKA AVA CONNECTION
AVA-1B, AVA-2B & AVA-4B

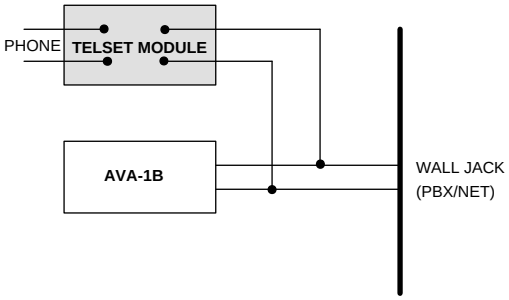
1.1.3 AVA-1B Personal Telephone Module

The PIKA AVA-1B supports an optional Personal Telephone module (TELSET) which provides a second telecom interface for direct connection to single line phones. The 'PHONE' port makes the phone 'believe' that it is connected to a phone system by providing power to it, detecting touchtone (DTMF) digit inputs and phone OFFHOOK state. In normal or idle mode operation, the PHONE port is directly connected to the NET/PBX port, and can operate without interference by the PIKA AVA-1B card as shown below:



AVA-1B IDLE MODE

The PHONE port can be disconnected from the PBX/NET port (ie 'SPLIT') under software control, to provide the phone user with a direct audio connection to the PIKA AVA-1B card, without any interaction with (or interference by) the PBX or NETWORK connection. This mode of operation is shown below:



AVA-1B SPLIT MODE

1.2 PIKA AVA B Series Feature Matrix

The PIKA AVA product line consists of the PIKA AVA-1B, 2B and 4B. Each card provides a different combination of features as listed in the following matrix:

FEATURE	AVA 1B	AVA 2B	AVA 4B
General			
Circuits (Lines)	1	2	4
Cards per Chassis	16	16	16
Circuits (Lines) per Chassis	16	32	64
On Board Buffer (Bytes/port)	0.5-16K	0.5-16K	0.5-16K
TELECOM			
Telephone Set Port	1(1)	None	None
NET/PBX Loop Start Interface	1	2	4
Ground Button Driver	Yes(1)	Yes(2)	Yes(2)
Phone to Net Line Split	Yes(1)	No	No
Local Phone OFFHOOK Detect	Yes(1)	No	No
Ringing Detect	Yes	Yes	Yes
Loop Supervision	Current	Current	Current
DTMF Receiver & Transmitter	1	2	4
Call Progress Analysis	Yes	Yes	Yes
MISCELLANEOUS			
LINE/MIC Input	1	1	1
MONITOR Output	1	1	1
Audio Sample Rate	3.5-14K	3.5-14K	3.5-14K
Music-on-Hold Output	Yes	No	No

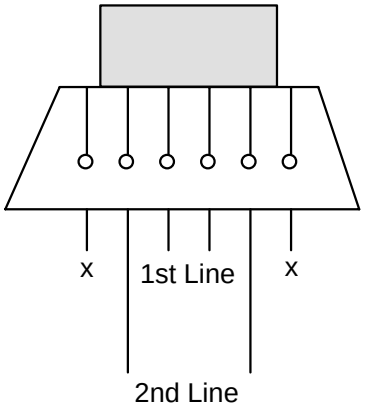
(1) Optional Personal Telephone Option (TELSET)
(2) Optional Ground Button Option

1.3 Installing PIKA AVA cards in a system

Prior to installing PIKA AVA cards in the system, read the hardware description section of the manual for the PIKA AVA model being used.

1. Configure the card hardware options as per the instructions in section 2.0 of this hardware manual.
2. To install an PIKA AVA card, first ensure that the system is turned OFF.
3. Find an empty slot (8-bit or 16-bit), and ensure that the chassis filler plate/bracket is removed for that slot.
4. Insert the PIKA AVA card into the card edge connector on the computer's mother board, ensuring that it is seated firmly.
5. Screw the PIKA AVA chassis bracket down, and close the chassis cover.

The RJ-14 telephone connectors used on all PIKA AVA cards use the same wiring convention as shown below:



MODULAR CORD PLUG (END VIEW)

Note that the polarity of the connection is not important on any of the PIKA AVA B Series cards.
Plug the telephone cables and/or LINE and MONITOR cables to the bracket end of the PIKA AVA card, as described in section 2.7.
The hardware is now ready to be turned on.

4. PIKA AVA Signal Levels

The following table indicates phone line audio levels corresponding to maximum PIKA AVA input/output (i.e. 5 volts peak to peak at A/D or D/A converter).

	Level VPk-Pk	**Level dBm**
Record	+0.38	-17.6
Play	+1.60	-2.9

2.0 HARDWARE DESIGN

The PIKA AVA B Series provide IBM AT or compatible computers with digital audio sampling/playback and telecom interface for multiple loop start ports.
PIKA AVA-1B, 2B and 4B cards support one, two and four channels respectively and can be installed in either single or multiple card systems, covering a wide range of system configurations and applications.
The structure of the hardware is shown in figure 1. Each channel contains a Telecom line loop start interface (NET/PBX INTERFACE). This circuit is used to perform the actual phone line functions related to call origination and transmission, including line seize, ringing voltage detection, loop current supervision, DTMF transmission, reception and audio coupling. The NET/PBX interface circuit is under direct control of the host computer, since its functions are not real-time intensive.
Each channel is further supported by a dedicated audio processor (AUDIO SAMPLER) which provides digital audio encoding, decoding, ADPCM compression, call progress tone and voice detection. This circuit directly interfaces to the host machine's bus for data transfers to and from the hard disk, and also relies on the system interrupts to ensure real-time servicing during play and record activities.
The PIKA AVA B series cards are mapped into the host systems I/O bus structure, with user relocatable base address and interrupts.
Each member of the PIKA AVA B series is 100% hardware and software compatible, allowing the 'mix and match' construction of systems. This scheme allows PIKA based systems to grow in either 1, 2 or 4 line increments with absolutely no modification of application software.

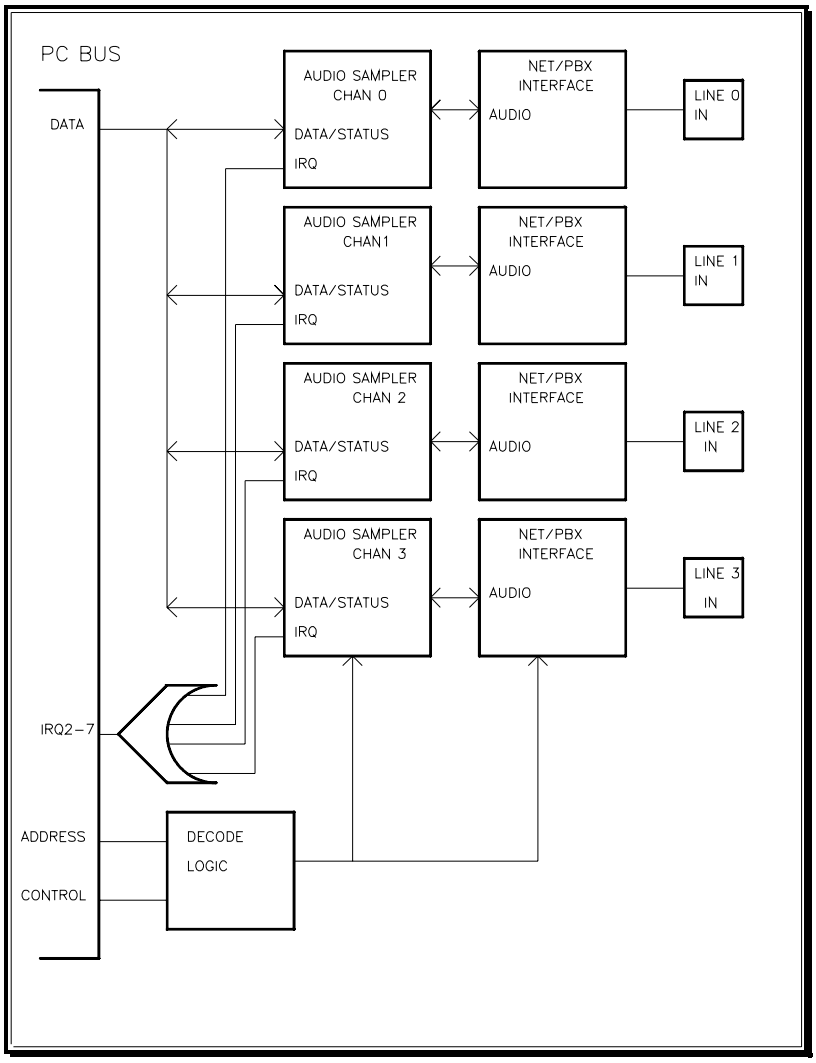


Fig. 1 PIKA AVA-4B Block Diagram

3.0 CONFIGURING THE PIKA AVA HARDWARE

This section describes the various user options.

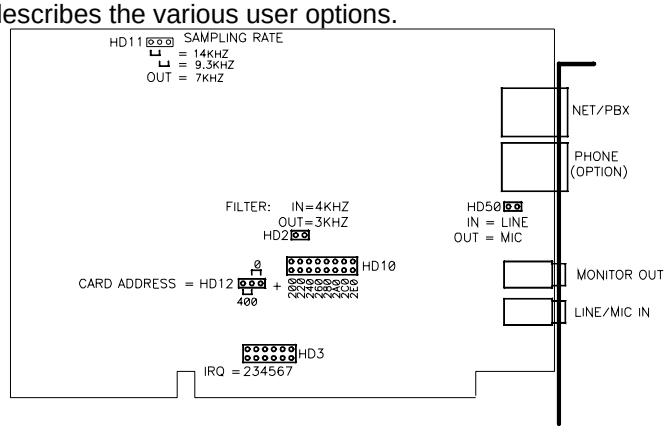
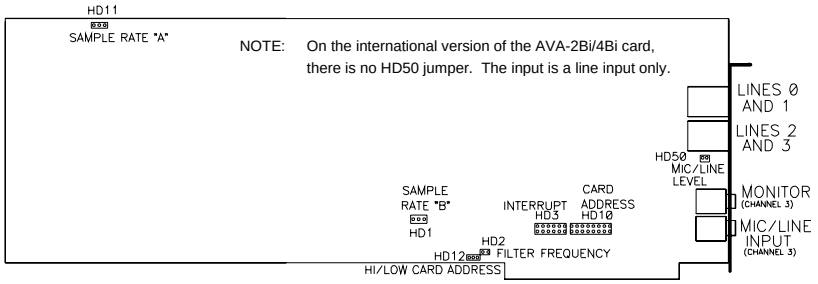
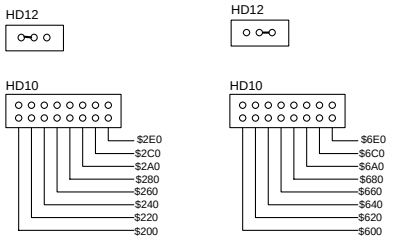


Fig. 2 PIKA AVA-1B Configuration





AVA 2B/4B Card Adress Selection

Fig. 3 PIKA AVA-2B/4B Configuration

3.1 Card Base Address

The PIKA AVA cards are factory set for a base address = $200-$21F to correspond with software defaults. The factory default settings can be reconfigured by a change to jumper blocks HD10 and HD12.

3.2 Interrupts

The PIKA AVA cards are factory set for interrupt IRQ3 to correspond with software defaults. The factory settings can be re-configured by a change to jumper block HD3 as shown
below:

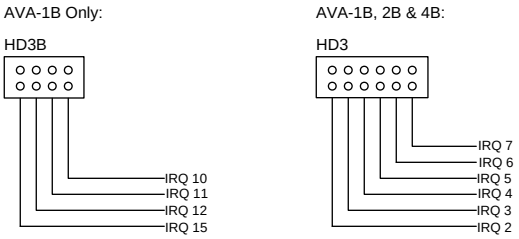


Fig 4. Card Interrupt Select

3.2.1 Multiple Card Interrupts

The correct operation of multiple PIKA AVA cards requires that all cards be connected to the same interrupt.

3.3 Audio Sampling rate

The audio sampling rate can be adjusted using jumper blocks HD1 and HD11 as shown in figure 5. The recorded audio quality improves as the sample rate increases, but at the expense of increased memory usage (see figure 6).

AVA-2B / 4B

HD11	HD1	
	○ ○—○	○—○ ○
○ ○ ○	3.5	7.0
○ ○—○	4.7	9.3
○—○ ○	7.0	14.0

AVA-1B

HD11	
○ ○ ○	7.0
○ ○—○	9.3
○—○ ○	14.0

Fig. 6 Sample Rate Options (kHz)

The amount of memory required for storage of digitized audio:

memory = (Sample Frequency) / 2 Bytes per second.

Sample (kHz)	KBytes/Sec	MBytes/Hr
3.5	1.75	6.3
4.7	2.35	8.5
7.0	3.50	12.6
9.3	4.65	16.7
14.0	7.00	25.2

Fig. 7 Data Storage Requirements

3.4 Filter Frequency

Low-pass filters are provided in the A/D direction for anti-aliasing as specified by the minimum Nyquist sampling bandwidth. ie:

Filter Frequency < (Sample Frequency / 2)

A filter is also provided in the D/A direction for output smoothing of the analog output signal. The filter cut-off frequency is set using jumper block HD2 as shown:

HD2	CUT OFF Frequency
OUT	3.2 kHz
IN	4.2 kHz

Fig. 8 Filter Frequency Options (kHz)

3.5 Mic/Line input

The PIKA AVA cards include an audio input port at the bracket end of the card. This audio input is connected to the fourth channel (ie CHANNEL 3) of the PIKA AVA-4B, the second channel (ie CHANNEL 1) of the PIKA AVA-2B and the first channel (ie CHANNEL 0) of the PIKA AVA-1B card. This input can be used for local non-telecom audio recording. Input connector J2 is a standard 0.125" (3.1mm) mini phone jack which can be jumper configured for LINE or MICROPHONE input levels.

HD50	MODE	Typical Input
OUT	MIC	5mvpp
IN	LINE	2vpp

Fig. 9 MIC/LINE port configurations

Use of the MIC/LINE input is not recommended at the same time as the telecom circuitry for a channel, as the recorded audio is a summation of the MIC/LINE and phone line audios.

3.5.1 Music On Hold

The PIKA AVA-1B provides the ability to directly transmit an external audio source from the MIC/LINE input to the NET/PBX port under software control.
This feature allows the PIKA AVA-1B to provide "Music-on-Hold" to the NET/PBX port while processing audio on the optional telephone port.

3.6 Monitor port

The PIKA AVA cards include an audio monitor port at the bracket end of the card. This port is connected to the audio output of CHANNEL 3 on the PIKA AVA-4B, CHANNEL 1 on the PIKA AVA-2B and CHANNEL 0 on the PIKA AVA-1B. Connector J1 is a standard 0.125" (3.1mm) mini phone jack which provides a general purpose audio monitor port from the card.
The monitor port output impedance is approximately 100 ohms, and should be used in conjunction with an external amplifier, i.e. IT CANNOT DRIVE A SPEAKER DIRECTLY.

3.7 Telecom Ports

The PIKA AVA cards contain one or two 6 conductor RJ14 type modular phone jacks at the bracket end of the card. Each connector is wired to standard loop-start line interface circuits, as shown in the following table:

Connector	Lead	Port#	PIKA AVA
J1	RED	Line 0	1B. 2B. 4B
	GREEN	Line 0	
	BLACK	Line 1	2B, 4B
	YELLOW	Line 1	
J2	RED	Line 2/Phone*	4B. 1B*
	GREEN	Line 2/Phone*	
	BLACK	Line 3	4B
	YELLOW	Line 3	

Fig. 10 PIKA AVA phone connector configurations

** If equipped with Personal Telephone (TELSET) Module*

3.7.1 Telecom port features

The telecom interfaces on the PIKA AVA cards NET/PBX ports feature the following resources:

a. Loop start termination.
b. Ringing voltage detector.
c. Loop disconnect detector.
d. DTMF ('touchtone') transceiver.
e. Call progress tone detector.
f. Audio record or playback.
g. Optional Ground key / outgoing ground start option.

Since each interface circuit does not share any of these resources, a fully non-blocking system can be implemented based on the PIKA AVA hardware.

3.7.2 Personal Telephone (TELSET) Module.

The optional PIKA AVA-1B optional Personal Telephone (TELSET) module features the following:

a.Local telephone feed

b.Local telephone OFFHOOK detect

c.Ground key / outgoing Ground Start

4.0 COMMON PIKA AVA QUESTIONS

Q: Besides number of channels, what is the difference between PIKA AVA-1B, 2B and 4B?

A: The PIKA AVA-2B and PIKA AVA-4B are identical except for the number of lines. The PIKA AVA-1B supports direct connection to a telephone for local record and playback with an optional Personal Telephone (TELSET) module. Phones can also be physically disconnected (SPLIT option) from the phone system under software control.

The PIKA AVA-1B also allows an external audio source connected to the MIC/LINE input to provide 'music on hold' to the NET/PBX port.

Q: Do I need to purchase a FIFO upgrade kit for my PIKA AVA cards?

A: The PIKA AVA has on-board FIFO audio buffers to allow the PC's CPU to operate on multiple channels. Standard size is 0.5Kbytes. The FIFOs are filled with new data periodically by the driver as the PIKA AVA plays audio. The PIKA AVA's FIFO operations occur at interrupt level, independent of most applications. If your application disables interrupts, or you have a slow access hard drive, FIFO interrupt servicing may be disrupted The following table shows how often the FIFOs must be serviced to ensure correct PIKA AVA operation:

Audio Sample Rate	FIFO SIZE (ALL TIMES IN MILLISECONDS)					
	0.5K	**1K**	**2K**	**4K**	**8K**	**16K**
7.0K	73	146	292	584	1164	2336
9.3K	55	110	220	440	880	1760
14.0K	36	72	144	288	456	912
19.6K	26	52	104	208	416	832

Your choice of FIFO option is made based on this table after determining your disk drive's access time, and your application's use of interrupts other than PIKA AVA's.

Q: How much disk storage space do I need for my application?

A: Storage space is dependent on audio sampling rate. As the sample rate drops, storage requirement reduces, but so does audio quality:

SAMPLE RATE	KBYTES/SEC	MBYTES/HOUR
7.0kHz	3.5	12.6
9.3kHz	4.7	16.7
14.0kHz	7.0	25.2

Q: How do I select the card address and interrupt for my PIKA AVA cards?

A: Determine what hardware is in your system (ie serial/parallel ports, other peripheral cards etc). If you have documentation on these cards, determine which card address and interrupts they use. Configure your PIKA AVA so that it does not use the same interrupt or address as any other cards in your system. The following shows a few typical examples:

CARD TYPE	INTERRUPT	ADDRESS
COM1	IRQ4	3F8-3FF
COM2	IRQ3	2F8-2FF
COM3	IRQ4	3E8-3EF
COM4	IRQ3	2E8-2EF
LPT1	IRQ7	3BC-3BF
LPT2	IRQ5	378-37F
Hard Disk	IRQ2	1F0-1F7
Floppy Disk	IRQ6	3F2-3F7
NOVELL	Selectable	2E0-2EF

Q: What's the difference between LINE and MICROPHONE input to my PIKA AVA?

A: The PIKA AVA card can be jumpered to accept either MIC or LINE levels. MIC level is compatible with standard microphones. LINE level is compatible with output from pre-amplified devices such as tape decks, CD players, 'walkmans', radios etc.

5.0 GLOSSARY

ADPCM:
Adaptive Delta Pulse Code Modulation. This is the scheme used by PIKA AVA cards for numerically representing audio signals.
This method minimizes hard disk and memory requirements by storing only the difference between adjacent samples rather than the actual samples themselves. In this scheme, data is stored in four bit nibbles, whose actual meaning adapts with the average signal level as a means of improving noise performance.

AUDIO SAMPLE RATE:
This is the rate at which audio signals are sampled for amplitude, and converted to binary representation of this amplitude (ie Analog to Digital Conversion rate). The PIKA AVA cards support a range of sample rates from 3.5kHz to 19.6kHz.

PIKA AVA-1B:
A single line - 1/2 size XT card supporting a NET/PBX interface, a LINE/MIC and MONITOR port and an optional Personal Telephone Module (TELSET). The PIKA AVA-1B is used for call answering and originate applications or general purpose audio play and record.

PIKA AVA-2B:
A two line PIKA AVA card, each line supporting a NET/PBX interface. Used for call answer or originate applications, or general purpose audio play and record.

PIKA AVA-4B:
A four line PIKA AVA card with NET/PBX loop start interfaces. The PIKA AVA-4B is used in voice servers for call answer and originate applications.

CALL PROGRESS TONES:
These are audible signals indicating the state of an outgoing call. These signals consist of specific combinations of
frequencies and cadences, each with a particular meaning such as: DIAL TONE, AUDIBLE RINGBACK, BUSY TONE, RE-ORDER TONE etc.

CENTRAL OFFICE
The central office or 'C.O.' is the location of the local telephone company's switching equipment. Lines from the telephone company C.O. are connected directly to homes and businesses.

DTMF:
Dual Tone Multi-Frequency or 'Touchtone' signals generated by push button phones. Each digit is a combination of two tones, One

representing the row, the other the column on the keypad where the key is located.

FIFO:

First In First Out memory device. FIFOs are used on each PIKA AVA audio circuit as a buffer for play or record audio data.
These buffers provide temporary storage for audio data blocks on the PIKA AVA card, allowing the computer system to operate efficiently on multiple PIKA AVA channels within the system.

GROUND BUTTON
A signal used in many non-North American countries to put somebody on HOLD. A user presses a button on the phone, which momentarily applies a ground signal to one of the phone line leads. This signals the phone system to put the far end party on hold. This feature is available as an option on the PIKA AVA-2B, AVA-4B and is standard with the PIKA AVA-1B optional Personal Telephone (TELSET) module.

GROUND-START INTERFACE
An interface between phone systems and the public network (C.O.). This interface operates much like a LOOP-START INTERFACE except during the start of a call. This interface is preferred for PBX systems since it eliminates 'glare' conditions caused by the PBX attempting to call out on a line which is calling in, but is still on the silence period of ringing.

HANGUP DETECTION:
Many phone systems can indicate that a caller at the other end of the connection has hung up by momentarily disconnecting the loop current from the phone line. The PIKA AVA detects loop current breaks to determine that a far end hangup has occurred.

HOOKFLASH
A signal used in many countries to put somebody on HOLD. A user either presses a button on the phone or taps the hookswitch to momentarily disconnect from the line. This signals the phone system to put the far end party on hold. This feature is provided on the PIKA AVA-1B, 2B and 4B.

KEY SYSTEM
This is the generic term for private telephone systems where subscribers must manually select a non-busy line to access the outside world (ie public network).

LINE/MIC PORT:
This port is a general purpose audio input port to the PIKA AVA card. This input is jumper selectable to be compatible either with LINE type levels (ie tape decks, CD players etc) or MICROPHONE type levels.

LINE SPLIT:
On PIKA AVA-1B with optional Personal Telephone (TELSET) module, the PHONE port can be physically disconnected, or 'split', from the NET/PBX port for audio input from a local telephone.

LOOP-START INTERFACE:
The standard PIKA AVA NET/PBX interface, which connects the PIKA AVA to the phone system by applying a DC termination across the phone line. This connection forms a DC current 'loop' from the phone system, through the PIKA AVA, and back to the phone system,

indicating that the PIKA AVA is 'offhook' and has started or answered a call.

MONITOR PORT

This port is a general purpose audio output port from the PIKA AVA card. This output cannot drive speakers directly; it provides output levels comparable to tape decks, CD players, etc. This port can drive high impedance headphones.

NET/PBX PORT:

This is where the PIKA AVA channels are connected to the public phone network or PBX system.

PBX/PABX

Private Automatic Branch Exchange. This is the generic term for private telephone systems where a subscriber can call to the outside world (ie public network) without knowledge of line status or selection (ie dial '9').

PHONE PORT:

Found on PIKA AVA-1B with optional Personal Telephone (TELSET) module. This is where the PIKA AVA is connected to a local single line (500/2500 type) phone. This port is physically connected to a corresponding NET/PBX port in normal operation, allowing the phones to operate without interference by the PIKA AVA card.

RINGING VOLTAGE:

Phone systems apply ringing voltage to a phone line to alert a station (ie phone, answering machine, voice mail machine etc) of an incoming call. Ringing voltage consists of an AC signal, frequency of 16 to 30 hertz, and amplitude of 70 to 110 volts AC onto the phone line.

TIP/RING

Refers to the pair of wires used for connecting the phone to telephone systems. Historically the name is derived from the name of the conductors on the plugs used in manual switchboards of the past.

TRUNK

Another name for a phone line between a PABX and the C.O.6.0 FCC

6.0 FCC INFORMATION

6.1 System Integrators

This section contains information applicable to system integrators, to ensure the use of the PIKA AVA complies with FCC part 68.

i. The PIKA AVA must be mounted into the final assembly so that it is isolated from exposure to any hazardous voltages with the assembly. Adequate separation and restraint of cables and cords must be provided.
ii. The TIP/RING leads from the PIKA AVA must be wired to the telephone lines in wiring that carries no other circuitry than that specifically allowed in FCC Part 68 rules. Any PC board traces carrying TIP/RING leads should have sufficient spacing to avoid surge breakdown.
iii. The PIKA AVA must be connected to a standard IBM XT/AT bus slot for correct power sources.
iv. When the PIKA AVA is enclosed within an assembly, a label shall be placed on the exterior of the cabinet listing registration numbers, and RENs of all registered devices contained therein.
v. The final assembler shall provide in the user manual, the standard Exhibit J customer instructions as listed in section 6.2 below.

6.2 Consumer Information

The following information applies to consumers, and is also to be included by system integrators in their customer documentation.

i. The PIKA AVA complies with Part 15 and Part 68 of the FCC rules. Verified to comply with the limits for Class "A" Digital Device pursuant to Part 15 of FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference in which case the user will be required to correct the interference at his own expense. On the solder side of the PIKA AVA board, is a label that contains the FCC registration number, and Ringer Equivalence Number (REN) for this equipment. If requested, provide this information to your telephone company.

ii. The REN is useful to determine the quantity of devices you may connect to your telephone line and still have all of those devices ring when your number is called. In most, but not all areas, the sum of the RENs of all devices should not exceed five (5.0). To be certain of the number of devices you may connect to your line, as determined by the REN, you should call your local telephone company to determine the maximum REN for your calling area.

iii. If your PIKA AVA causes harm to the telephone network, the telephone Company may discontinue your service temporarily. If possible, they will notify you in advance. But if advance notices is not practical, you will be notified as soon as possible.

iv. Your telephone company may make changes in its facilities, equipment, operations, or procedures that could affect the proper operation of your equipment. If they do,

you will be given advance notice so as to give you an opportunity to maintain uninterrupted service.

v. If you experience trouble with the PIKA AVA, please contact PIKA Technologies, 155 Terrence Matthews Cres., Kanata, Ontario K2M 2A8 Tel: 1-613-591-1555, Fax: 1-613-591-1488 for repair/warranty information. The telephone company may ask you to disconnect this equipment from the network until the problem has been corrected or you are sure that the equipment is not malfunctioning.

vi. The PIKA AVA may not be used on coin service provided by the telephone company. Connection to party lines is subject to state tariffs. (Contact your state public utility commission or corporation commission for information).

vii. For the Netherlands only: You are not allowed to use pulse-dialing for outbound calling. You are allowed to use DTMF dialing.

viii. For the Netherlands only: The equipment might not respond at all PSN's. You can get more information about this from the PTT network facility.

7.0 DOC INFORMATION

7.1 Equipment Attachment Limitations

NOTICE: The Canadian Department of Communications label identifies certified equipment. This certification means that the equipment meets certain telecommunications network protective, operational safety requirements. The Department does not guarantee the equipment will operate to the user's satisfaction.

Before installing this equipment, users should ensure that it is permissible to be connected to the facilities of the local telecommunications company. The equipment must also be installed using an acceptable method of connection. In some cases, the company's inside wiring associated with a single line certified connector assembly (telephone extension cord). The customer should be aware that compliance with the above conditions may not prevent degradation of service in some situations.

Repairs to certified equipment should be made by an authorized Canadian maintenance facility designated by the supplier. Any repairs or alterations made by the user to this equipment, or equipment malfunctions, may give the telecommunications company cause to request the user to disconnect the equipment.

Users should ensure for their own protection that the electrical ground connections of the power utility, telephone lines and internal metallic water pipe system, if present, are connected together. This precaution may be particularly important in rural areas.

Caution: Users should not attempt to make such connections themselves, but should contact the appropriate electric inspection authority, or electrician, as appropriate.

7.2 Load Numbers (LN)

The LOAD NUMBER (LN) assigned to each terminal device denotes the percentage of the total load to be connected to a telephone loop which is used by the device, to prevent overloading. The termination on a loop may consist of any combination of devices subject only to the requirement that the total of the Load Numbers of all the devices does not exceed 100.

7.3 Restrictions Concernant Le Raccordement De Materiel

AVIS: L'etiquette du ministere des Communications du Canada indentifie le materiel homologue. Cette etiquette certifie que le materiel est conforme a certaines normes de protection, d'exploitation et de securite des reseaux de telecommunications. Le Ministere n'assure toutefois pas que le materiel fonctionnera a la satisfaction de l'utilisateur.

Avant d'installer ce materiel, l'utilisateur doit s'assurer qu'il est permis de le raccorder aux installations de l'entreprise locale de telecommunication. Le materiel doit egalement etre installe en suivant une method acceptee de raccordement. Dans certains cas, le fils interieurs de l'entreprise utilises pour un service individuel a ligne unique peuvent etre prolonges au moyen d'un dispositif homologue de raccordement (cordon prolongateur telephonique interne). L'abonne de doit pas oublier qu'il est possible que la conformite aux conditions enoncees ce-dessus n'empechent pas la degradation du service dans certaines situations. Actuellement, les entreprises de telecommunication ne permettent pas que l'on raccorde leur materiel a des jacks d'abonne, sauf dans le cas precis prevus pas les tarrifs particuliers de ces entreprises.

Les reparations de materiel homologue doivent etre affectuees par un centre d'entretien canadien autorise designe par le fournisseur. La compagnie de telecommunications peut demander a l'uitilisateur de debrancher un appareil a la suite de reparations ou de modifications effectuees par l'utilisateur ou de modifications effectuees par l'utilisateur ou a cause de mauvais fonctionnement.

Pour sa propre protection, l'utilisateur doit s'assurer que tous le fils de mise a la terre de la source d'energie electrique, des lignes telephoniques et de canalisations d'eau

metallique, s'il y en a , sont raccordes ensemble. Cette precaution est particulierement importante dans le regions rurales.
Avertissement: - L'utilisatuer ne doit pas tenter de faire ces raccordements lui-meme; il doit avoir recours a un service d'inspection des installations electriques, ou a electricien, selon le cas.
7.4 L'indices de Charge (IC) L'indice de charge (IC) assigne a chaque dispositif terminal indique, pour eviter toute surcharge, le pourcentage de la charge totale qui peut etre raccordee a un circuit telephonique boucle utilise par ce dispositif. La terminaison du circuit boucle peut etre constituee de n'import quelle combinaison de dispositifs, pourvu que la somme des indices de charge de l'ensemble des dispositifs ne depasse pas 100.

SECTION B

CALL PROGRESS TONE DETECTION

RELEASE 3 FOR DOS

B-SERIES

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1. Introduction

Telephone networks are designed to provide users with audible indication of call status by use of 'Call Progress Tones' (CP tones). These CP tones allow users to determine if a call is successful or unsuccessful.
The AVA supports automated dialing into telephone networks by providing capability for detecting and analyzing CP tones and to determine the status of a call.
AVA call analysis consists of a two step process, starting with an automated 'learn' procedure which is run at time of installation. The learn procedure creates data patterns representing the characteristics of the local call progress tones.
The second step in AVA call analysis occurs in real-time by scanning phone line and attempting to match audio activity to the learned patterns, thus determining the status of outgoing calls.

1.2. Call Progress Tone Characteristics.

CP tones consist of combinations of frequencies and cadences, The most familiar being DIAL TONE, BUSY TONE, RINGBACK and REORDER TONE.
The following table outlines a list of standard CP tones.

TONE NAME	FREQ (Hz)	CADENCE (sec)	DESCRIPTION
Dial Tone	350 + 440	ON	Far end ready to receive dial pulse/DTMF digits.
Ringback	440 + 480	2 ON 4 OFF	Called line has been reached, ringing started.
Busy	480 + 620	0.5 ON 0.5 OFF	Called line has been reached, but is busy.
Reorder	480 + 620	0.25 ON 0.25 OFF	Local path to C.O. is busy or unassigned code.

A study of typical applications shows that cadence detection is a reliable method of detecting CP tones, and determining the success (ie answer) or failure of a call.
The AVA provides a flexible call analysis detection scheme based on detection of CP tone signal energy cadences. This detection scheme allows designers to tailor their system to any required cadence scheme, providing reliable detection of all international CP tones.

1.3. Call Analysis Algorithm

The AVA's CP tone detection software scans the phone line for audio energy within a pre-determined amplitude and frequency range. The software determines the real-time cadence of the energy on the line, identifying which CP tone is present:

a. Audible ringback
b. Busy tone
c. Fast busy (re-order) tone.
d. Silence
e. Dial Tone

When a call progress detection session begins, the AVA waits for the occurance of audio energy on the phone line. When energy is detected, the AVA attempts to match the cadence patterns detected in real-time to pre-determined patterns for each of the tones above (See A.3.1). The following list describes the actions taken by the AVA as patterns are matched:

a. Audible ringback: Continue scanning until pattern does not match RINGBACK, indicating call has been answered. Returns a CONNECT message to the application.
b. Busy tone: Returns a BUSY FOUND message to the application.
c. Fast busy: Returns a FAST BUSY FOUND message to the application.
d. Silence: Returns a NO RINGBACK FOUND message to the application.
e. Dialtone: Returns a NO RINGBACK FOUND message to the application.

1.4. Call Progress Learn Utility

The AVA driver is supported by the utility 'pikacpl.exe' which provides a mechanism to automatically learn the call progress tone cadences of a particular installation. This utility produces a data structure compatible with the AVA's 'ava_set_cpl' routine.

1.4.1. Call Progress Learn Algorithm

The pikacpl utility scans the phone line for the occurrance of audio energy at 52mSec intervals, producing a string of binary information representing 'ENERGY FOUND = 1" and 'SILENCE FOUND = 0'.
The data pattern is then analyzed to remove any apparent noise by applying 'debouncing' factors which determine valid high and low groups of bits. The Energy (Hi) debounce parameter determines the minimum number of consecutive ONEs scanned to determined that a silent line has become active. The Silence (Low) debounce parameter determines the minimum number of consecutive ZEROs scanned to determine that an active line has gone silent.
This operation will eliminate spurious transitions in the data stream providing a 'cleaned up' representation of the call progress tone cadence being learned.
An example follows:

for Energy debounce = 4
and Silence debounce = 3

Scanned Data:

11111001110001000001111001110001100000111 1...

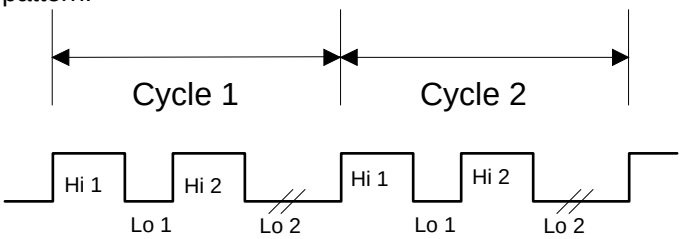
Debounced Data:

11111111110000000001111111110000000000111 1...

The next step in learning the call progress pattern is to process this debounced data into a template for pattern matching, also representing the data in a compact format.

The algorithm used for extracting patterns from this raw data is based on the following:

The following shows the pattern for 'DOUBLE RINGING' type cadence, which by inspection is the most complex call progress pattern:



Therefore, by assuming no call progress tone pattern is more complex than above, it follows that all patterns can be represented as a repeating group of four bits, consisting of ONEs and ZEROs (Hi1, Lo1, Hi2 and Lo2).

The debounced scan data is analysed according to this algorithm, starting at the first occurance of energy (ie = Hi1).

The number of scans for each group is counted, and averaged over the entire period of the learn session to determine the nominal size of each of the four groups (measured in number of 52mSec samples).

The final step in learning a call progress pattern is to build some tolerances into the pattern detection. Since variations will typically occur from call to call or even cycle to cycle, the debounced data stream is also analysed to determine the allowable worst case deviations (in percent) from the calculated nominals, thus providing a tolerance factor when matching to call progress patterns.

1.4.2. Using pikacpl

The 'pikacpl' utility allows a call to be made to a number where a known condition exists, and as such a known call progress pattern can be learned.

Users run the program from the DOS command line as described below. Once started, the program will automatically perform the learn operation.

The utility compiles learn information on BUSY, FAST BUSY (re-order tone) and RINGING in a binary file (default pikacpl.out).
It is recommended that at least one run is made for each condition to ensure accurate information in pikacpl.out.
Note: *If you do not, or cannot, run 'pikacpl' for FAST-BUSY, the program will automatically insure that it is the same as the busy tone.*
The CP learn program displays a real-time compilation of cadence measurememts made during the call (see figure 1). When the call is completed, the program will dump a summary of scanned data, and the recommended tolerances to be used by the AVA driver. Although this information is not required by the user, it can be usefull in debugging future call analysis problems. These results can be piped to a text file using the standard dos piping command after issuing the 'pikacpl' command:

pikacpl -option -option cpfile.out

A useful feature of 'pikacpl' is that the system speaker will beep synchronously with the presence of any call progress tones present on the phone line during the learn process. This feature is invaluable for debugging and supporting the call progress learn function.
The following command line options are available with this utility:

-?	-- This help screen
-n<num>	-- Automatically dial this string (0-9#*& or ,)
-b<num>	-- Dial busy signal for num times (def 5)
-f <num>	-- Dial fast busy signal for num times (def 5)
-r<num>	-- Dial ringing signal for num times (def 5)
-e<num>	-- Energy debounce (def 2 scans)
-g<num>	-- Only do num groups per call (def 5)
-s<num>	-- Silence debounce (def 2 scans)
-t<num>	-- Tolerance addition percentage (def 20)
-p<port io>	-- Port address in hex for AVA channel 0 (def 200)
-o<file>	-- Output filename (def pikacpl.out)

Option Details:

-n : Automatically dials the digit string entered.

Digit strings may be any combination of 0 to 9, #, or *. Control character include '&' for hookflash (loop disconnect) and ',' for 1 second pause. If this option is not used, the program will pause, prompting the user for a number string.

-b : Assumes that 'BUSY' signal will be learned.

Choose a phone number which will produce BUSY tone when called, (ie extension OFF-HOOK) prior to running 'pikacpl'. parameter indicates the number of calls 'pikacpl' will make to that number to learn the BUSY signal. The default value is 5.

-f : Assumes that 'FAST-BUSY' signal will be learned.

Choose a phone number which will produce FAST-BUSY tone when called, (ie invalid extension number) prior to running 'pikacpl'.

If FAST-BUSY is not learned, 'pikacpl' automatically defaults the results to equal the BUSY tone.

parameter indicates the number of calls that 'pikacpl' will make to that number to learn the FAST-BUSY signal. The default value is 5.

-r : Assumes that 'RINGING' signal will be learned.

Choose a phone number which will produce RINGING tone when called (ie extension ON-HOOK) prior to running 'pikacpl'.

parameter indicates the number of calls the AVA will make to that number to learn the RINGING signal. The default value is 5.

-g: Selects the number of tone bursts (or ON / OFF / ON / OFF groups) to learn for this run.

Typically this is 5, but in some phone systems this maybe too many, as the tones halt after 3-4 cycles.

-e : Sets debounce parameter for audio energy detection.

The value of <num> = the minimum number of consecutive 52mSec audio energy scans required to determine that a silent phone line now has audio energy is present. (Default = 2, or 50 to 100mSec).

-s : Sets debounce parameter for audio silence detection.

The value of <num> = the minimum number of consecutive 52mSec audio energy scans required to determine that energy on phone line has gone silent. (Default = 2, or 50 to 100mSec).

-t : Allows setting an extra margin of tolerance for detection of patterns.

The value of this parameter is added directly to the variations from the nominal sizes of pattern groups 'Hi1, Lo1, Hi2, Lo2' calculated during the learn process.

The default for 't' = 20.

Example: Suppose learn found:

Hi1 nominal = 10 counts.

largest = 12 counts.

smallest = 7 counts.

The resulting worst case deviation for Hi1 is 10-7 = 3. This deviation represents a percent tolerance of:

100 * (3/10) = +/- 30%

By selecting t=20, the net tolerance used by AVA is:

30% + 20% = +/- 50%

The result is that Hi1 will be matched for a scan of:

10 +/- 50% = 5 to 15 counts.

A zero value for this parameter is not recommended, since it leaves no margin of tolerance should a transient situation arise which did not during call progress learning. A large value for this parameter is also not recommended, since it may increase the tolerance to such an extent as to cause difficulty in determining a call connect condition.

-p : Allows changing the default I/O port for performing CP learn.

This program uses AVA channel 0, which is located at the lowest configured AVA port, which typically starts at I/O address 200hex. If the system does not use 200 as the address for AVA channel 0, this parameter allows the user to specify where it is located (ie 220, 240, 260 etc...)

See 'CARD ADDRESS SELECTION' section of the AVA hardware manual.

-o : Allows routing the results of 'pikacpl' to a filename other than the default 'pikacpl.out'.

Examples:

PIKACPL4 -n215 -b3 -g4:

Calls extension 215, expecting a busy signal. Call will be repeated three times. Four ON/OFF groups will be learned.

PIKACPL4 -n210 -r1:

Calls extension 210, expecting ringing signal.

PIKACPL4 -n205 -f -p220:

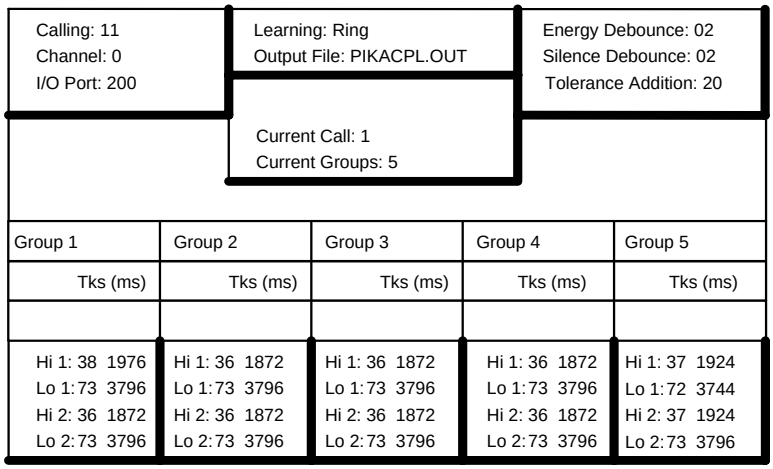
Calls extension 205, expecting fast busy signal. Call will be repeated five times. The PIKA AVA port is set to 220.

Sample Run:

Suppose you have an extension 11 on your phone system. Ensure that the phone is on hook, then type the following command from the DOS prompt:

PIKACPL4 -n11 -r1

PIKACPL4 program will display the following screen, dial extension 11, and begin filling the screen with data. You will also note the your system's speaker will beep synchronously with the ringing of the telephone. This allows you to audibly verify that the call has been sucessful, by confirming the ON/OFF cadence of the tone.



RECOMMENDED PARAMETERS

Parameter	Average	Maximum	Minimum	Tolerance
High	36	41	32	25%
Low 1	73	80	64	21%
Low 2	73	80	64	21%

Press 'S' to save results, 'Q' to quit.

Note the following fields of interest on the screen:

Calling: 11 = Dialed extension 11

I/O port: 200 = PIKA AVA hardware address 200.

Learning: Ring = Calling a non-busy extension, learning ringing.

Tolerance: Once the call has completed, the numbers in this column will be updated and should not exceed 50% for successful runs.

Once completed, you will be asked to type S to save the information. The procedure is now repeated for BUSY. Take extension 11 off hook, then type the following command from the DOS prompt:

PIKACPL4 -n11 -b1

The same screen will appear with appropriate status information, and when complete you will again be asked to type S to save the information.

The procedure can now be repeated for FAST-BUSY (re-order) if your system will generate it. Typically this is done by dialing an illegal extension number. Suppose your telephone system has extensions from 10 to 50. If you dial say, 60, you will likely hear the FAST-BUSY signal.

If you cannot produce the FAST-BUSY signal by dialing any extension, don't worry, since PIKACPL4 will automatically ignore FAST-BUSY.

If you can produce a FAST-BUSY, then enter the following command from the DOS prompt:

PIKACPL4 -n60 -f1

The same screen will appear with appropriate status information, and when complete you will again be asked to type S to save the information.

The call progress tone learn procedure is complete, and need not be run again, unless your telephone system is changed.

1.4.3. Using 'pikacpl.out'

The output of the 'pikacpl' program (default 'pikacpl.out') is a binary file which can be copied DIRECTLY into the input data structure for the AVA driver. See section B.4.18 "ava_set_cpl() - Set call progress parameters".
Note: *Structures should always be byte aligned.*